

NASA/SP—1998-7011/SUPPL476  
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# **AEROSPACE MEDICINE AND BIOLOGY**

A CONTINUING BIBLIOGRAPHY WITH INDEXES



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<b>51</b>	<b>Life Sciences (General)</b>	<b>1</b>
<b>52</b>	<b>Aerospace Medicine</b> Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.	<b>2</b>
<b>53</b>	<b>Behavioral Sciences</b> Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.	<b>4</b>
<b>54</b>	<b>Man/System Technology and Life Support</b> Includes human engineering; biotechnology; and space suits and protective clothing.	<b>5</b>
<b>55</b>	<b>Space Biology</b> Includes exobiology; planetary biology; and extraterrestrial life.	<b>N.A.</b>

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# Typical Report Citation and Abstract

- ❶ 19970001126 NASA Langley Research Center, Hampton, VA USA
- ❷ **Water Tunnel Flow Visualization Study Through Poststall of 12 Novel Planform Shapes**
- ❸ Gatlin, Gregory M., NASA Langley Research Center, USA Neuhart, Dan H., Lockheed Engineering and Sciences Co., USA;
- ❹ Mar. 1996; 130p; In English
- ❺ Contract(s)/Grant(s): RTOP 505-68-70-04
- ❻ Report No(s): NASA-TM-4663; NAS 1.15:4663; L-17418; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche
- ❼ To determine the flow field characteristics of 12 planform geometries, a flow visualization investigation was conducted in the Langley 16- by 24-Inch Water Tunnel. Concepts studied included flat plate representations of diamond wings, twin bodies, double wings, cutout wing configurations, and serrated forebodies. The off-surface flow patterns were identified by injecting colored dyes from the model surface into the free-stream flow. These dyes generally were injected so that the localized vortical flow patterns were visualized. Photographs were obtained for angles of attack ranging from 10° to 50°, and all investigations were conducted at a test section speed of 0.25 ft per sec. Results from the investigation indicate that the formation of strong vortices on highly swept forebodies can improve poststall lift characteristics; however, the asymmetric bursting of these vortices could produce substantial control problems. A wing cutout was found to significantly alter the position of the forebody vortex on the wing by shifting the vortex inboard. Serrated forebodies were found to effectively generate multiple vortices over the configuration. Vortices from 65° swept forebody serrations tended to roll together, while vortices from 40° swept serrations were more effective in generating additional lift caused by their more independent nature.
- ❽ Author
- ❾ *Water Tunnel Tests; Flow Visualization; Flow Distribution; Free Flow; Planforms; Wing Profiles; Aerodynamic Configurations*

## Key

1. Document ID Number; Corporate Source
2. Title
3. Author(s) and Affiliation(s)
4. Publication Date
5. Contract/Grant Number(s)
6. Report Number(s); Availability and Price Codes
7. Abstract
8. Abstract Author
9. Subject Terms

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# AEROSPACE MEDICINE AND BIOLOGY

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*A Continuing Bibliography (Suppl. 476)*

OCTOBER 19, 1998

## 51

### LIFE SCIENCES (GENERAL)

**19980218117** NASA, Washington, DC USA

**Life Sciences Program Tasks and Bibliography for FY 1997**

Nelson, John C., Editor, NASA, USA; Feb. 1998; 1050p; In English

Report No.(s): NASA/TM-1998-206987; NAS 1.15:206987; No Copyright; Avail: CASI; A99, Hardcopy; A10, Microfiche

This document includes information on all peer reviewed projects funded by the Office of Life and Microgravity Sciences and Applications, Life Sciences Division during fiscal year 1997. This document will be published annually and made available to scientists in the space life sciences field both as a hard copy and as an interactive internet web page.

Author

*Life Sciences; Microgravity Applications; Bibliographies; NASA Programs*

**19980218254** New Energy and Industrial Technology Development Organization, Tokyo, Japan

**Research study on analysis/use technologies of genome information** *Genome joho kaidoku riyo gijutsu no chosa kenkyu*

Mar. 1997; 154p; In Japanese

Report No.(s): NEDO-PR-9601; DE98-745387; No Copyright; Avail: Issuing Activity (Natl Technical Information Service (NTIS)), Microfiche

For wide use of genome information in the industrial field, the required R and D was surveyed from the standpoints of biology and information science. To clarify the present state and issues of the international research on genome analysis, the genome map as well as sequence and function information are first surveyed. The current analysis/use technologies of genome information are analyzed, and the following are summarized: prediction and identification of gene regions in genome sequences, techniques for searching and selecting useful genes, and techniques for predicting the expression of gene functions and the gene-product structure and functions. It is recommended that R and D and data collection/interpretation necessary to clarify inter-gene interactions and information networks should be promoted by integrating Japanese advanced know-how and technologies. As examples of the impact of the research results on industry and society, the present state and future expected effect are summarized for medicines, diagnosis/analysis instruments, chemicals, foods, agriculture, fishery, animal husbandry, electronics, environment and information.

DOE

*Agriculture; Animals; Data Acquisition; Diagnosis; Fisheries; Genes*

**19980218874** San Jose State Univ., Dept. of Biological Sciences, CA USA

**The Coupling of Solution Chemistry to Plant Nutrient Demand in an on Demand Nutrient Delivery System** *Final Report*

Savage, Wayne, San Jose State Univ., USA; 1998; 6p; In English

Contract(s)/Grant(s): NCC2-5179; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The goal of the proposal will be to determine the suitability of the DASI instrument in providing a signal that can be recognized and be utilized as an indicator of plant stress. The method to be utilized for evaluating stress is the presentation of an every increasing level of nutrient deficiency and salinity stress (addition of salt (NaCl) or increasing concentration of balanced nutrient) while simultaneously recording spectral reflectance using the DASI instrument and monitoring the traditional processes of gas exchange and nutrient uptake parameters. In this manner, we will be able to directly compare the DASI measurements with known stresses as determined by the traditional gas exchange and nutrient uptake measures of stress. We anticipate that the DASI will provide a sensitive identifier of plant stress; recording signals of the resulting changes in plant metabolism in real time, far before any visible effects of stress could be observed. Thus, there is a potential for very early management intervention to correct a stress condition before damage could develop. The present response time for the observation of visual symptoms of plant stress is consid-

erable and only provides an indication that a stress is present after it has been present for an extended period of time. Thus, the impact of a plant-based life support function will have already been significant. An additional benefit of this research to regenerative life support will be the characterization of a potential recovery scenario from various degrees of stress. The experimental approach to be employed includes the removal of the stress at various points in the stress gradient and the characterization of plant performance and reflectance spectra during recovery from various degrees of stress. Spectral reflectance imaging techniques have been developed and used to measure the biochemical composition of plants and relate these characteristics to the fluxes of biochemical elements within the ecosystem.

Derived from text

*Imaging Techniques; Plant Stress; Nutrients; Gas Exchange; Life Support Systems*

## 52

### AEROSPACE MEDICINE

*Includes physiological factors; biological effects of radiation; and effects of weightlessness on man and animals.*

**19980216516** Louisiana State Univ., Pennington Biomedical Research Center, Baton Rouge, LA USA

**Determination of Total Daily Energy Requirements and Activity Patterns of Service Women Annual Report, 26 Sep. 1996 - 25 Sep 1997**

Delany, James P., Louisiana State Univ., USA; Oct. 1997; 15p; In English

Contract(s)/Grant(s): DAMD17-96-2-6025

Report No.(s): AD-A346857; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The objective of the current study is to define a range of energy requirements of servicewomen, defining the variation as it relates to jobs, military settings, and activity patterns. This is crucial information needed not only for determination of nutritional requirements for energy balance, but specific nutrient density standards for servicewomen. Total daily energy expenditure will be measured using the doubly labeled water (DLW) method. Activity patterns from actigraphs will be analyzed for hours of sleep, description of job/work patterns by examining bursts of concerted activity versus steady activity. Men will also be studied in many of these settings. Energy requirements for men have been better established and will serve to anchor the results obtained in women to previously established norms in men. Several field studies will be conducted over the course of the grant. The first field study was conducted at Fort Bragg/Camp Mckall during a Combat Support Hospital training exercise, during the first year of the grant. Isotope and activity monitor analyses for all samples are nearly complete and final calculations and study report will be completed within the next 4-6 months. Identification of the next population to study is underway.

DTIC

*Nutrition; Balance; Education; Energy Budgets; Energy Requirements; Females; Nutritional Requirements; Fatigue (Biology)*

**19980217140** California Univ., Dept. of Psychology, Santa Cruz, CA USA

**[Activities of Psychology Dept., California Univ.] Progress Report**

Bridgeman, Bruce, California Univ., USA; 1998; 4p; In English

Contract(s)/Grant(s): NCC2-1003; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

We have completed two studies during the grant period, with manuscripts published or ready for submission for publication: (1) Dual adaptation and adaptive generalization in the human vestibuloocular reflex and (2) Frequency vs. acceleration specificity in human VOR adaptation. In the 1st study two studies examined the possibility that rotational VOR plasticity is subject to dual adaptation and adaptive generalization. Subjects in the experimental condition were exposed to an altered visual-vestibular environment for about four minutes every day for five consecutive days. The working hours between these testing sessions constituted re-exposure to the normal visual environment. Thus, subjects were repeatedly adapting and re-adapting to both environments which is a condition designed to produce dual adaptation. In each training session a measure of baseline VOR gain was obtained (in the dark). A small laser spot (the only visual stimulus) was systematically moved in the same direction as the subject's head, but by half the angle of rotation (target/head gain = 0.5). This resulted in adaptation values relativized to the non-adapted gain of each subject. These values were then analyzed using an analysis of variance with day and session (within a day) as factors. In the 2nd study human VOR adaption has been assumed to be frequency specific, despite the fact that the semicircular canals are simulated by rotational acceleration and not frequency per se.

Derived from text

*Analysis of Variance; Vestibules; Semicircular Canals; Psychology; Human Tolerances; Adaptation*



**19980218119** Health Effects Inst., Cambridge, MA USA

**Mechanism of Oxidative Stress from Low Levels of Carbon Monoxide, May 1995 - Jun. 1996**

Thom, S. R., Health Effects Inst., USA; Ischiropoulos, H., Health Effects Inst., USA; Dec. 1997; 44p; In English  
Report No.(s): PB98-151608; HEI/RR-80/97; Copyright; Avail: Issuing Activity (Nat'l Technical Information Service (NTIS)), Microfiche

The purpose of this study was to determine whether platelets and vascular endothelial cells liberate nitric oxide (NO) and NO-derived oxidant species after exposure to carbon monoxide (CO). We hypothesized that exposure to environmentally relevant concentrations of CO would increase production of agents that may be involved in human pathological processes, such as atherosclerosis.

NTIS

*Platelets; Nitric Oxide; Cells (Biology); Exposure*

**19980218439** Stanford Univ., Hopkins Marine Station, Pacific Grove, CA USA

**The Regulation of Gene Expression in Cnidarian-Algal Associations Final Report, 1 Jul. 1992 - 5 May 1998**

Levine, R. Paul, Stanford Univ., USA; Jul. 13, 1998; 6p; In English

Contract(s)/Grant(s): N00014-92-J-1856-P00001

Report No.(s): AD-A349126; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

We have characterized genes encoding heat shock proteins and proteins of the ubiquitin system. Constitutive forms of the HSP60 and 70 families of heat shock proteins and an inducible form of HSP60 occur in symbiotic and aposymbiotic *A. patia pallida*. We have constructed cDNA libraries from aposymbiotic *A. pallida* and symbiotic *A. pallida* and *Anthopleura elegantissima*. We have a complete sequence for *A. pallida* HSP60. We have completed the comparison of protein profiles of *A. elegantissima* (see J. Exp Biol. 1996, 199:883-892) and have identified three symbiosis-specific proteins. One is carbonic anhydrase with an apparent molecular weight of 31 kDa and a pI of 6.3. We have obtained N-terminal sequence for second protein; it has an apparent molecular weight of 32 kDa and a pI of 7.9. It does not align with any sequences in the GenBank data base. A third symbiosis-specific protein, having an apparent weight of 30 kD and a pI of 5.6, crossreacts with a monoclonal anti-HSP70 antibody. The synthesis of this protein is enhanced in animals subjected to elevated temperatures and in animals maintained in the dark. Further investigations of these proteins are underway by Dr. Virginia Weis at Oregon State University.

DTIC

*Genes; Algae; Gene Expression; Pathology; Thermal Shock; Coding*

**19980218579** Illinois Univ., Dept. of Veterinary Biosciences, Urbana, IL USA

**Development of Corneal Equivalents for In Vitro Testing of Ocular Irritants Final Report, 1 Mar. 1995 - 30 Apr. 1998**

Eurell, Thomas E., Illinois Univ., USA; Jul. 02, 1998; 14p; In English

Contract(s)/Grant(s): F9620-95-1-0168; AF Proj. 2312

Report No.(s): AD-A349607; AFRL-SR-BL-TB-98-0535; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Using tissue culture methods developed by our research team, we have achieved standardized methods for producing organotypic models of the rabbit and human cornea. One rabbit cornea will provide enough seed culture cells to produce 40-50 rabbit corneal equivalents. One human cornea will provide enough seed culture cells to produce 3-5 human corneal equivalents. No live animals were used in this research project as we obtained the rabbit eyes from a meat processing plant. Human corneal tissue was recovered from post-surgical specimens following corneal transplant surgery. Immunologic techniques were used to develop a reference biomarker database. Interleukin-1 (IL-1) was not detected in the rabbit or human native tissue or the rabbit corneal equivalents. intercellular adhesion molecule-1 (ICAM-1) and Fibronectin (FN) were inconsistently found in the human and rabbit native tissue and were not detected in the rabbit corneal equivalents. Heat Shock Protein 70 (HSP70) was consistently detected and cataloged in a reference database for both the human and rabbit native tissue and the rabbit corneal equivalents. Rabbit organotypic corneal models demonstrated characteristic histopathologic changes such as coagulative necrosis and liquefactive necrosis following in vitro exposure to prototypic chemicals.

DTIC

*Adhesion; Animals; Catalogs (Publications); Cornea; Culture Techniques; Data Bases; Exposure*

**19980218635** Agency for Health Care Policy and Research, Rockville, MD USA

**Signal-Averaged Electrocardiography. Health Technology Assessment Number 11**

Graham, A. A., Agency for Health Care Policy and Research, USA; Handelsman, H., Agency for Health Care Policy and Research, USA; May 1998; 30p; In English

Report No.(s): PB98-137227; AHCPR-98-0020; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Signal-averaged electrocardiography (SAECG) is technique involving computerized analysis of segments of a standard surface electrocardiogram. It is used for detecting small electrical impulses, termed ventricular late potentials, that follow the QRS segment. They are embedded in the electrocardiogram but ordinarily obscured by skeletal muscle activity and other extraneous sources of 'noise' encountered in recording a standard electrocardiogram.

NTIS

*Activity (Biology); Computer Techniques; Detection; Diagnosis; Electrocardiography; Embedding*

## 53

### BEHAVIORAL SCIENCES

*Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.*

**19980216513** Secretary of the Air Force, Inspector General, Washington, DC USA

#### **Broad Area Review of the Enhanced Flight Screening Program**

Mar. 17, 1998; 116p; In English

Report No.(s): AD-A346804; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

This review fulfills a Secretary of the Air Force tasking to conduct a Broad Area Review (BAR) of the Enhanced Flight Screening (EFS) program to reduce risk. On 16 Dec 97, the team began reviewing data and identifying hazards. The data review included the draft Air Education and Training Command BAR on the EFS program, other program documentation, operations and maintenance manuals and procedures, and applicable Federal Aviation Administration (FAA) regulations. Initial hazard identification was performed through functional expert brainstorming, review of the draft AETC BAR, and use of the Air Force Safety Center's 5-M (Mission, Man, Machine, Media, and Management) Risk Identification Model. From 4-21 Jan 98, the team conducted interviews, reviewed data, and inspected facilities and equipment at locations involved with the EFS program. The team also conducted telephone interviews with the Federal Aviation Administration (FAA) (in both Washington DC and at the Small Aircraft Directorate, Kansas City MO), and with personnel involved with the original T-3A acquisition and testing. Next, the team assessed the current EFS program against established goals and standard Air Force practices. This assessment completed the hazard identification process and provided data necessary to determine risks to the EFS program's safety and screening effectiveness. This risk was determined by evaluating a hazard's probability of occurrence and severity. Once these risks were identified, the team evaluated methods to mitigate to levels considered acceptable.

DTIC

*Flight Training; Personnel; Data Management; Hazards; Safety*

**19980218775** Institute for Human Factors TNO, Soesterberg, Netherlands

#### **Training with Simulated Team Members Interim Report Trainen met gesimuleerde teamleden**

Verstegen, D. M. L., Institute for Human Factors TNO, Netherlands; Nov. 13, 1997; 40p; In Dutch

Contract(s)/Grant(s): B97-033

Report No.(s): TNO-TM-97-B023; TD-97-0255; Copyright; Avail: Issuing Activity (TNO Human Factors Research Inst., Kampweg 5, 3769 DE Soesterberg, The Netherlands); US Sales Only, Hardcopy, Microfiche

A task is labelled as a team task when people have to conduct a task that each of them could not have done alone. Team tasks consist of three components: 1 The individual tasks of the team members. 2 The cooperation and coordination between team members. 3 The motivation and attitudes of the team members. These components are vital for team performance and should therefore also be addressed during the training of teams. However, the field of team training is still underdeveloped, especially for training regarding the second component: the cooperation and coordination between team members. For some fields or aspects training concepts have been developed, e.g. cross-training and Crew Resource Management training. But it is not clear whether these training concepts can be used for other kinds of team tasks. Little research has addressed the issue of the timing of training regarding the different components. In most cases the team members are first trained individually until they have mastered their own individual tasks. Then team members train together to learn how to cooperate and how to coordinate their tasks. Whether this is always the optimal trajectory is unknown. Both training in teams and training individually have advantages and disadvantages. Individual training is easier to control and the training can be adapted to one particular student. However, the three components can only be integrated when team members are training together. and this improves the transfer of knowledge and skills. Practicing with simulated team members offers the advantages of training apart and training together. Both the individual tasks and the cooperation with other team members can be addressed systematically. Moreover, the student can be better prepared for the real task situation with scenarios where the simulated team members are programmed to function suboptimally. Implementing simulations of team

members is, however, a difficult and labour under intensive task. Therefore, it is proposed to test the validity of the new training concept by replacing the simulations by experts who are trained to perform in a standard way.

Author

*Education; Coordination; Teams; Human Performance*

## 54

### MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT

*Includes human engineering; biotechnology; and space suits and protective clothing. For related information see also 16 Space Transportation.*

**19980215581** Freshaire Systems and Technology, Inc., Cleveland, OH USA

**Portable Electrochemical Oxygen Concentrator for Battlefield Combat Casualty Care Final Report, 1 Jul. 1997 - 28 Feb. 1998**

Burk, Melvyn, Freshaire Systems and Technology, Inc., USA; Mar. 1998; 26p; In English

Contract(s)/Grant(s): DAMD17-97-2-7011

Report No.(s): AD-A347568; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The primary goal of this overall research and development program is to design and construct a Portable ElectroChemical Oxygen Concentrator (PECOC) capable of producing nearly pure (greater than 98%) oxygen from the ambient atmosphere at room temperature. This novel device relies on the two-electron reduction of oxygen to peroxide at a high area carbon-based, gas-permeable, Teflon-bonded (HAC-GPTB) cathode, which then migrates through a thin solid polymer electrolyte (SPE) membrane to a gas-diffusion (GD) anode, where it is oxidized to yield dioxygen. Two major aspects were emphasized during this first six-month period: the identification of highly active, highly specific electrocatalysts for the two-electron reduction of O<sub>2</sub> to peroxide and for the oxidation of peroxide to O<sub>2</sub> in acid media and the construction of a prototype stack reactor capable of delivering pure oxygen at levels comparable to those required for field medical applications (3 L/min). Significant progress was made in both of these areas. In particular, a simple surface modifier for platinum was found to promote the quantitative reduction of dioxygen peroxide at small overpotentials in dilute phosphoric acid as evidenced by rotating ring-disk techniques results. Furthermore, a full size PECOC unit built from commercially procured materials was shown to deliver pure dioxygen in several independent trials.

DTIC

*Electron Transitions; Life Support Systems; Electrocatalysts; Concentrators; Research and Development; Design Analysis; Fabrication; Oxygen Analyzers*

**19980216735** Texas Univ. Health Science Center, School of Public Health, Houston, TX USA

**Incidence of USA Air Force Aircrew Fatigue in the Operational Setting**

Lee, Karl E., Texas Univ. Health Science Center, USA; Jun. 10, 1998; 65p; In English

Report No.(s): AD-A346896; AFIT-98-025; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Though subjective fatigue measures have been utilized in assessing aircrew fatigue, no studies to date have attempted to establish its overall incidence in the USAF flying community. The purpose of this study was to investigate the incidence of subjective fatigue in the USAF operational environment, looking specifically at those pilots and flight engineers that regularly fly long transport missions. The study group included all pilots and flight engineers belonging to the USA Air Force Reserve's 68TH Airlift Squadron stationed at Kelly AFB, TX. This squadron has approximately 65 pilots and 70 flight engineers and utilizes the C-S Galaxy transport aircraft exclusively. Pre and postmission questionnaires were completed prior to and at mission completion respectively. Throughout the mission, the study subjects completed a mission log, which tracked type of activity, serial fatigue rating, and place of sleep. Subjective fatigue was rated starting at mission onset, every four hours throughout the mission and at mission completion, that is, at time of engine shut down. Fatigue was measured using the School of Aerospace Medicine (SAM) seven point fatigue scale. Despite the endorsement of the wing commander, full support of the wing safety officer, two separate briefings to the squadron at monthly safety briefings, and placement of questionnaire packets in over 135 individual's vertical files (V-files or "mail boxes), only six questionnaire packets were returned. Despite the lack of response, this study does serve as a pilot study, which together with lessons learned may prove useful in future studies of USAF aircrew fatigue in the operational setting.

DTIC

*Safety; Transport Aircraft; Sleep; Fatigue (Biology)*

**19980218123** Haas Tailoring Co., Baltimore, MD USA

**Extractions of Garment Manufacturing Data from 3D Whole Body Scans *Final Report, 18 Sep. 1996 - 18 Sep 1997***

McLean, Michael L., Sr., Haas Tailoring Co., USA; Newsom, Benjamin, Haas Tailoring Co., USA; Feb. 18, 1998; 162p; In English

Contract(s)/Grant(s): SPO100-95-D-1044

Report No.(s): AD-A347501; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

The project is to develop a computer-based, interactive measurement and posture data acquisition system. The system will be implemented as a Microsoft-Windows(95/NT) computer program which accepts 3D whole body scan data and produces manufacturing oriented measurement and posture specifications. For the men's uniform there are approximately 24 different measurements or posture specifications which may be required. For the women's uniform there are approximately 30 different measurements or posture specifications to handle. As measurements and posture specifiers are derived, they are "validated" against statistical norms and ranges. The data for these statistical norms on human build resides in the Haas Tailoring anthropomorphic data base of over 8,000 military personnel and over 75,000 members of the general population. These validated measurements and posture specifications will be automatically submitted to a pattern design system to produce a special measure pattern. Systems under considerations are the Haas Tailoring Expert System, the Gerber Garment Made-to-Measure System, and/or other garment CAD systems.

DTIC

*Computer Programs; Posture; Scanners; Manufacturing; Human Body; Computer Techniques; Computer Aided Design*

**19980218872** Valdosta State Univ., Valdosta, GA USA

**Testing an Algae-Based Air-Regeneration System *Final Report***

Nienow, James, Valdosta State Univ., USA; 1998; 31p; In English

Contract(s)/Grant(s): NAGw-4897; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The potential of an air-regeneration system based on the growth of unicellular algae on the surface of porous ceramic tubes was evaluated. The system is fairly robust with respect to environmental conditions and is capable of maintaining algal cultures for up to 365 days. Under standard conditions (50-66 micro mol/sq mm s (PPF), 450 micro mol mol of CO<sub>2</sub>), mature tubes can remove CO<sub>2</sub> at a rate of up to 90 micro mol/sq m min. Under these conditions, approximately 200 square meters of area would be required for each member of the crew. However, the rate of uptake increases with both photon flux and CO<sub>2</sub> concentration in accordance with Michaelis-Menton dynamics. An extrapolation to conditions of saturating light and carbon dioxide indicates that the area required can be reduced by a factor of at least 2.5.

Author

*Performance Tests; Regeneration (Engineering); Regenerators; Algae; Oxygen Production*

# Subject Term Index

## A

ACTIVITY (BIOLOGY), 4  
ADAPTATION, 2  
ADHESION, 3  
AGRICULTURE, 1  
ALGAE, 3, 6  
ANALYSIS OF VARIANCE, 2  
ANIMALS, 1, 3

## B

BALANCE, 2  
BIBLIOGRAPHIES, 1

## C

CATALOGS (PUBLICATIONS), 3  
CELLS (BIOLOGY), 3  
CODING, 3  
COMPUTER AIDED DESIGN, 6  
COMPUTER PROGRAMS, 6  
COMPUTER TECHNIQUES, 4, 6  
CONCENTRATORS, 5  
COORDINATION, 5  
CORNEA, 3  
CULTURE TECHNIQUES, 3

## D

DATA ACQUISITION, 1  
DATA BASES, 3  
DATA MANAGEMENT, 4  
DESIGN ANALYSIS, 5  
DETECTION, 4  
DIAGNOSIS, 1, 4

## E

EDUCATION, 2, 5  
ELECTROCARDIOGRAPHY, 4  
ELECTROCATALYSTS, 5  
ELECTRON TRANSITIONS, 5  
EMBEDDING, 4  
ENERGY BUDGETS, 2  
ENERGY REQUIREMENTS, 2  
EXPOSURE, 3

## F

FABRICATION, 5  
FATIGUE (BIOLOGY), 2, 5  
FEMALES, 2  
FISHERIES, 1  
FLIGHT TRAINING, 4

## G

GAS EXCHANGE, 2  
GENE EXPRESSION, 3  
GENES, 1, 3

## H

HAZARDS, 4  
HUMAN BODY, 6  
HUMAN PERFORMANCE, 5  
HUMAN TOLERANCES, 2

## I

IMAGING TECHNIQUES, 2

## L

LIFE SCIENCES, 1  
LIFE SUPPORT SYSTEMS, 2, 5

## M

MANUFACTURING, 6  
MICROGRAVITY APPLICATIONS, 1

## N

NASA PROGRAMS, 1  
NITRIC OXIDE, 3  
NUTRIENTS, 2  
NUTRITION, 2  
NUTRITIONAL REQUIREMENTS, 2

## O

OXYGEN ANALYZERS, 5  
OXYGEN PRODUCTION, 6

## P

PATHOLOGY, 3  
PERFORMANCE TESTS, 6  
PERSONNEL, 4  
PLANT STRESS, 2  
PLATELETS, 3  
POSTURE, 6  
PSYCHOLOGY, 2

## R

REGENERATION (ENGINEERING), 6  
REGENERATORS, 6  
RESEARCH AND DEVELOPMENT, 5

## S

SAFETY, 4, 5  
SCANNERS, 6  
SEMICIRCULAR CANALS, 2  
SLEEP, 5

## T

TEAMS, 5  
THERMAL SHOCK, 3  
TRANSPORT AIRCRAFT, 5

## V

VESTIBULES, 2

# Personal Author Index

## B

Bridgeman, Bruce, 2  
Burk, Melvyn, 5

## D

Delany, James P., 2

## E

Eurell, Thomas E., 3

## G

Graham, A. A., 3

## H

Handelsman, H., 3

## I

Ischiropoulos, H., 3

## L

Lee, Karl E., 5  
Levine, R. Paul, 3

## M

McLean, Michael L., Sr., 6

## N

Nelson, John C., 1  
Newsom, Benjamin, 6  
Nienow, James, 6

## S

Savage, Wayne, 1

## T

Thom, S. R., 3

## V

Verstegen, D. M. L., 4

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